3.7 Vegetation

3.7.1 Summary

The purpose and need for the Border Project identified structural and compositional vegetation concerns. In general, there is an over abundance of aspen and a lack of conifer. Also, there are very few acres within the young age classes for the major Landscape Ecosystems (LE) within the Project area.

Figure 3.7-1. Changes to Conifer Forest Types in the Border Project Area

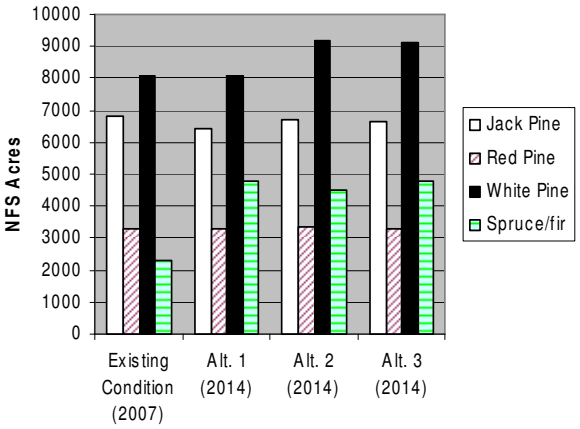
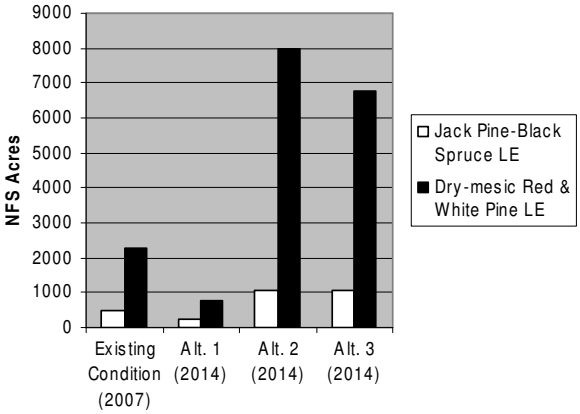


Figure 3.7-2. Change in the Young Age Class (0-9 years) in the Border Project Area



Alternative 1 would result in no new management of the vegetation. Natural processes would continue and would result in the Forest not moving towards Forest Plan LE objectives for young forest and vegetation composition. This alternative would move the Forest towards the LE objectives for increasing spruce-fir and decreasing aspen through natural succession of forest ecosystems.

Alternative 2 would move the Forest towards meeting LE objectives for species composition, age class distribution, and for tree species diversity within individual stands. This alternative would harvest the largest amount of acres, and would also provide for the most acres to be converted to conifer (Figure 3.7-1).

Alternative 3 would move the Forest towards meeting LE objectives for species composition, age class distribution, and for tree species diversity within individual stands. This alternative would create slightly less young forest than Alternative 2 (Figure 3.7-2), and would provide for less conversion to conifer. This alternative also defers management activity near the Boundary Waters Canoe Area Wilderness (BWCAW), Voyageurs National Park (VNP), and removes some proposed management activity within the Vermilion River corridor as compared to Alternative 2.

3.7.2 Introduction

Forest Plan Direction

Forest Plan objectives seek conditions more representative of native vegetation communities than what currently exist. The vegetation section discusses the effects that each alternative is expected to have on the vegetative structure and composition of the Project area as it relates to moving the forest towards Forest Plan desired conditions. Effects are displayed by Landscape Ecosystem (LE). LEs represent the most current and best scientific information to use in analyzing forest vegetation. LEs were described and delineated as part of the Forest Plan revision. Each LE is characterized by its dominant vegetation communities and patterns, which are a product of local climate, glacial topography, dominant soils, and natural processes such as succession, fire, wind, insects, and disease (Forest Plan p. 2-55). Pages 2-55 to 2-78 of the Forest Plan present vegetation objectives for the different LEs on the Forest.

Five LEs are within the Project area: Dry-Mesic Red and White Pine (DRW), Jack Pine-Black Spruce (JPB), Lowland Conifer A (LLC-A), Mesic Red and White Pine (MRW), and Mesic Birch-Aspen-Spruce-Fir (MBA). The Dry-Mesic Red and White Pine LE constitute the majority of the Project area (67%). The only other LEs with considerable acres are the Jack Pine-Black Spruce and Lowland Conifer A (11% and 5%, respectively). The other two Landscape Ecosystems (Mesic Red & White Pine and Mesic Birch-Aspen-Spruce-Fir) consist of less than 1% of the Project area, and would see very little management, therefore are not discussed further in this section.

Five of the ten Management Areas (Forest Plan p. 3-1) for the Superior National Forest (outside of the BWCAW) are found within the Project area, and they are: General Forest (46%), General Forest-Longer Rotation (27%), Recreation Use in a Scenic Landscape (11%), Semi-primitive Motorized Recreation (10%), and Eligible Wild, Scenic, and Recreational River (6%). Activities are proposed in all Management Areas (MA) under each of the two action alternatives. Forest Plan objectives common to these Management Areas include managing for long-lived conifer species. Generally speaking, the General Forest MA will have more even-aged management and less site conversion to conifer, as compared to the General Forest-Longer Rotation MA.

Development of the Border Project

Forest Plan vegetation objectives were developed considering past, current, and future expected vegetative conditions of all lands within the Northern Superior Uplands (Forest Plan 2-55 to 2-60). They were also developed considering the conditions of the BWCAW and the conditions of other ownerships. These Forest Plan vegetation objectives apply to National Forest System (NFS) lands outside the BWCAW. Forest Plan cumulative effects analysis took into account not only NFS land, but State of Minnesota, St. Louis County, and private lands as well.

When the Forest Plan was developed it also took into consideration the desired future conditions put forth by the Minnesota Forest Resource Council's Northeast Landscape Committee (*Recommended Desired Outcomes, Goals and Strategies for the Northeast Landscape Region, 2003*). Through this committee, major landowners within the region have generally agreed to an overall vision of how the northeastern Minnesota landscape may look over the next 50 years. As a participant in the process, the Forest Service will

coordinate management with other land managers in each landscape (Forest Plan EIS, Appendix H, p.H-9). Some of the broad goals of the committee were to move the regional vegetation to provide for diverse habitat to maintain natural communities and viable populations for species native to northeastern Minnesota, and to have spatial patterns (size and location of openings) that are consistent with the ecology of northeastern Minnesota (Forest Plan EIS, Appendix H, p.H-10).

In addition to the broad goals mentioned above, the committee also had goals that are more specific to each landscape ecosystem (LE). Goals that are specific to the LEs found within the Border Project include:

- Underplant red and white pine (DRW LE)
- Maintain stands currently dominated by red and white pine (DRW LE)
- Restore pine in stands currently dominated by aspen (DRW LE)
- Enhance white pine and multi-aged spruce-fir and pine-spruce-fir (DRW LE)
- Maintain jack pine where it currently exists (JPB LE)
- Restore jack pine through a variety of methods as site dictates (JPB LE)

Design of the Border Project strives to move toward forest vegetation management objectives as described in the Forest Plan (Forest Plan 2-20 to 2-27). Both action alternatives follow management direction striving to achieve goals for sustainable forest product uses in an environmentally acceptable manner and providing a sustainable level of commercially available timber (Forest Plan 2-20, D-TM-1). The white pine management indicator species objective has also been incorporated in the white pine objectives for the landscape ecosystems (Forest Plan 2-35, O-WL-32 and O-WL-33). Vegetation management, designed to meet the desired future condition, would be accomplished through timber harvest, planting, and release activities in addition to natural succession.

The process of developing the Border Project used an interdisciplinary team approach by reviewing all stands within the Project boundary. From this, stands were identified for management activity based on their condition, and how managing them could contribute to meeting Forest Plan desired future conditions. Many vegetation treatments were focused on increasing overall patch size. The action alternatives would provide for larger upland young patch sizes. When these patches mature in 40-60 years, they would then contribute to larger upland mature patches than what exists currently in the Project area. Action was deferred in various stands based on wildlife, recreational, social, soil, riparian area, or economic constraints such as low volume stands, or cost of road building to remote stands. After several reviews, meetings, and public input, the pool of stands was reduced by the interdisciplinary team to the proposed stands in this document.

Appendix C shows the types of treatments and the sequence of those treatments that are to take place in stands proposed for vegetation treatment. The table also lists how many acres would be treated with each method of treatment by each alternative. Vegetation treatment definitions and information can be found in Appendix A.

3.7.3 Analysis Methods

The Border Project's effects analysis for the vegetation resource is tiered to the Forest Plan Environmental Impact Statement (Forest Plan EIS). The Forest Plan EIS considered the role of disturbance, the range of natural variability, ecological classifications, and landscape ecosystems. The Forest Plan EIS disclosed the effects of implementing the Forest-wide objectives. The Border Project effects analysis discloses the effects of the Project on vegetation and how each alternative would contribute towards meeting Forest Plan objectives and desired future conditions. The Border EIS does not repeat the analysis documented in the Forest Plan EIS (see Forest Plan EIS p. 3.1-20 to 3.2-49). The Forest Plan provides for three specific measurable objectives for each LE. These objectives focus on the species composition, age class distribution, and within-stand diversity for each LE. These objectives are measurable, and so they provide a good way to disclose effects to vegetation and to compare how the Border Project's alternatives would move each LE toward the Forest Plan's desired future condition.

Indicator 1
Species composition

This indicator describes the change in species composition or forest type as a result of each alternative in the Project area. Some proposed management activities would change a stand's forest type. Natural succession and disturbance may also change a stand's forest type. This indicator highlights the differences between alternatives because the proposed management activities would produce varying amounts of forest types over time. The amount and distribution of forest types may also have direct implications on biological diversity, old age classes, wildlife habitat, and forest products.

The Superior National Forest monitors the populations and habitat for four Management Indicator Species (MIS). Eastern white pine, which is an MIS, will be discussed in this section. The other three species (bald eagle, gray wolf, and northern goshawk) are discussed in the wildlife section. Forest Plan objective O-WL-32 (Forest Plan, p.2-35) seeks to increase the amount of white pine to amounts more representative of native plant communities. This can be measured by the change within forest type as a result of each alternative, and to a lesser extent by the change in species composition in other forest types where white pine is a component.

Indicator 2
Age class distribution

This indicator describes the change in age class distribution as a result of each alternative in the Project area. This indicator highlights the differences between alternatives because the proposed management activities would produce varying amounts of forest ages over time. The amount of forests in different growth stages may also have direct implications on wildlife habitat, old age classes, and forest products.

Indicator 3
Within-stand diversity

This indicator describes the change in within-stand diversity as a result of each alternative. This indicator highlights the difference in alternatives because the different treatment methods would result in different effects to within-stand diversity. For this

analysis, within-stand diversity refers to both overall structure and species diversity. Vertical structure is the bottom to top configuration of above ground vegetation within a forested stand and varies with forest type and ages. Stand complexity changes markedly during forest succession, from a relatively simple structure in early successional stands to more complex structures displayed as stands age (Forest Plan EIS 3.2-33).

3.7.4 Analysis Area

The geographic boundary selected for analyzing the direct and indirect effects is identical to the Border Project boundary. The Analysis Area includes only a part of the three major LEs found in the Project area (Dry-mesic Red and White Pine, Jack Pine-Black Spruce, and Lowland Conifer), even though each LE extends well beyond the Border Project boundary. The direct and indirect effects analysis includes National Forest System land only. This Analysis Area was chosen because it shows how the actions which occur on National Forest System land within each LE of the Border Project help to meet the objectives of the Forest Plan for each particular LE, and disclose the effects on vegetation within those LEs. While LEs span across the entire Superior National Forest, proposed actions for this are limited to the Border Project boundary, however, effects of those actions will be reflected for the entire LE.

The Border Project boundary also serves as the boundary for the cumulative effects analysis. This area considers all known activities across all ownerships within the Border Project. This Analysis Area was chosen because it is the appropriate scale to consider the proposed actions with the known activities of other owners within the same Project boundary.

The time period selected for the direct, indirect, and cumulative effects analysis is seven years into the future. Data used to establish the existing condition is from 2007, which would mean the analysis period would go to 2014. This timeline was chosen because seven years is a sufficient amount of time for proposed actions from this to be carried through and analyze what its effects are to vegetation. Using seven years as a timeline also allows for comparison to Forest Plan goals and objectives for LEs, as 2014 is the end of decade one of the Plan. Also, by 2014, all actions from previous environmental analyses would be completed and effects to vegetation would be known.

Since the existing condition is a very reliable snapshot of past cumulative effects on forest types and age class, the forest type and age class distribution of the Project area in year 2007 would reflect all prior commercial harvests and stand replacement natural disturbances. Thus, this cumulative past as described by the existing condition is well represented under all the alternatives.

3.7.5 Affected Environment

The forest that exists today evolved as a result of both natural and human processes. The pioneer logging that occurred during the late 19th and early 20th century, followed by widespread slash-fueled wildfires, altered the composition and structure of the original forests. The next era of logging started in the 1940s and has continued to the present. Recent timber management and fire suppression activities have contributed to current forest conditions. Past logging practices have fragmented the landscape, and the suppression of fire has created an artificial buildup of fuels within the forest. Natural disturbance and forest succession have also taken place to varying degrees on managed

and unmanaged lands within the Border Project area. The forest that exists today is different from the forest that would have evolved under purely natural processes.

Each of the landscape ecosystems (LE) that exist in the Border Project area have objectives for species composition, age class distribution, and for within stand diversity. The Forest Plan established these objectives by not only considering the historic composition and structure of the Forest, but by considering the desired future condition. Each affected LE's current condition in regards to these objectives is discussed below.

Species Composition

Each forest stand is identified by a forest type. Vegetation composition refers to the different forest types such as jack pine, red pine, aspen, etc. Forested stands in the Project area are a mix of species. The Forest Plan EIS describes some of the limitations in forest typing (page 3.3.1-3), recognizing that most forest types are more diverse in species composition than is indicated by their type. For example, many stands identified as red pine could also be called white pine stands and vice-versa. The Superior National Forest inventory system does not have a mixed red-white pine forest type option. Forest types are established based on available data, and using professional judgment as to where the stand may be trending.

Species composition tables show two sets of numbers. The first set of numbers shows the percent of each forest type Forest-wide. The percentages are shown for the existing condition, the projected condition in 2014 (assumes implementation of Border Alt. 2), and Forest Plan objectives for decade one. The second set of numbers is specific to the Border Project area. The numbers show the breakdown of forest type by acres, and include the existing condition, Alternative 1, Alternative 2, and Alternative 3.

Tables 3.7-1 and 3.7-2 show the Border Project area species composition as it was in 2007 (existing condition column). Both the Dry-mesic Red and White Pine and the Jack Pine-Black Spruce LEs are dominated by the aspen forest type (50% and 40%, respectively). Many of these stands consist of decadent aspen with balsam fir regenerating in the understory. Aspen occupies the most acreage due to past practices of harvesting other forest types and allowing aspen to occupy them, which consequently allowed this type to be much more dominant on the landscape than had naturally occurred in the past. White pine, which is a Management Indicator Species (MIS), is the second most dominant forest type within the Dry-mesic Red and White Pine LE, representing 17% of the LE within the Project area. The remaining acres for the DRW LE within the Project area are scattered mainly amongst jack pine, red pine, and the spruce-fir forest types. The remaining acres in the Jack Pine-Black Spruce LE are concentrated in jack pine and white pine, with smaller amounts in the red pine, spruce-fir, and paper birch forest types.

Age Class Distribution

Each forest stand is identified by an age class. Age class is broken down by decade, or as seen in Tables 3.7-3 to 3.7-5, can be displayed in a range of decades. Age class distribution tables are displayed much in the same manner as vegetation composition tables. The first set of numbers shows Forest-wide percentages in each age class, while the second set of numbers show acres in each age class, and are specific to the Border Project area. Each landscape ecosystem has a different set of age class ranges based on

the varying growth stages that are typical for each LE. Forested stands become two-aged when an understory becomes established prior to the death of the mature overstory. An example of this would be an 80-100 year old aspen stand breaking up due to old age and the gaps created then become occupied by balsam fir or white spruce saplings. In the age class tables, these stands would be counted under the age of the overstory until it has broken apart and the understory begins to dominate.

Currently, within the Dry-mesic Red and White Pine LE, most of the acres fall in three age classes (10-49, 50-99, and 100-139). There are 2,280 acres in the 0-9 age class. Most of the acres in this age class come from past management activity that dates back to 1992. The most recent activity that has taken place within a part of the Border Project area is the Holmes-Chipmunk EIS that was signed in 2003. There are only 242 acres in the 140+ age class. Currently, the Jack Pine-Black Spruce LE (Table 3.7-4) has a large amount of acreage in two distinct age classes. The acres in the 10-49 age class are mostly a result of modern era logging, while the acres in the 80-109 age class are possibly a mix of logging and natural processes. Stands closer to 80 years old could be a result of re-growth after initial logging near the turn of the century, while stands closer to 109 years old have the possibility of being from natural origins as they may have been too young to harvest during the original logging boom of the late 19th and early 20th century. Currently, the age class composition for the Lowland Conifer-A LE (Table 3.7-5) is heavily skewed towards the older age classes. Most of the acres fall within the 80-159 age class, and are of natural origin. There is a distinct lack of acres within the 0-9 age class. For a long time, lowland cover types were not actively managed. Furthermore, the lowland cover types within the Border Project area are not very commercially productive, which has led to a lack of treatments in the recent past.

Table 3.7.1 Vegetation Composition in the Dry-Mesic Red and White Pine LE

Upland Forest Type	Forest-wide [1]			Border Project Area[3] (Acres)			
	Existing Condition (2007)	Projected Condition (2014)[4]	Objectives[2] for Decade 1	Existing Condition (2007)	Alt. 1	Alt. 2	Alt. 3
Jack pine	9%	9%	10%	5,460	5,092	5,252	5,214
Red pine	13%	14%	13%	2,919	2,919	2,974	2,906
White pine	9%	10%	9%	6,803	6,803	7,890	7,856
Spruce-fir	8%	11%	11%	2,025	4,200	3,938	4,212
Oak	0%	0%	0%	35	35	35	35
Northern hardwoods	1%	1%	1%	654	654	654	654
Aspen	51%	47%	47%	19,498	17,738	16,800	16,668
Paper birch	9%	8%	9%	896	850	746	747
Total	100%	100%	100%	38,290	38,290	38,290	38,290

[1] Percent of National Forest System land in the Dry-mesic Red and White Pine LE.
[2] Superior National Forest, Forest Plan, page 2-64, Table DRW-1.
[3] Figures displayed for all alternatives reflect NFS land in year 2014.
[4] See Appendix G for list of projects included in projection.

Table 3.7.2 Vegetation Composition in the Jack Pine-Black Spruce LE							
Upland Forest Type	Forest-wide [1]			Border Project Area[3] (Acres)			
	Existing Condition (2007)	Projected Condition (2014)[4]	Objectives[2] for Decade 1	Existing Condition (2007)	Alt. 1	Alt. 2	Alt. 3
Jack pine	23%	24%	28%	1,352	1,332	1,453	1,453
Red pine	10%	10%	10%	376	376	376	376
White pine	4%	5%	3%	1,257	1,273	1,280	1,280
Spruce-fir	12%	15%	15%	273	561	580	580
Oak	0%	0%	0%	75	75	75	75
Northern hardwoods	1%	0%	0%	66	66	66	66
Aspen	46%	41%	40%	2,512	2,228	2,082	2,082
Paper birch	5%	5%	5%	257	257	257	257
Total	100%	100%	100%	6,169	6,169	6,169	6,169

[1] Percent of National Forest System land in the Jack Pine-Black Spruce LE.
[2] Superior National Forest, Forest Plan, page 2-61, Table JPB-1.
[3] Figures displayed for all alternatives reflect NFS land in year 2014.
[4] See Appendix G for list of projects included in projection.

Within Stand Diversity

During the 2007 field season, informal stand condition assessments were completed on many stands within the Project area. In stands that were visited, structural and species diversity were found to be moderate in mature age classes. Many of these stands are short lived species such as aspen, birch, and jack pine which are likely to have substantial amounts of dead, dying, and down wood available. Some of the stands have gaps in the canopy with shade tolerant species such as balsam fir or spruce beginning to fill in the understory. Decadent aspen and birch are being replaced by spruce and fir in the understory. Mature red and white pine stands have various levels of understory established within them, providing for vertical structure.

In the middle age classes (10-49 and 50-99) of the two upland LEs, within stand diversity varies. Many of these stands were created from past timber sales. Stands that were regenerated artificially such as red pine plantations tend to have very little structural or species diversity. Areas that were regenerated naturally often contain more species diversity, with the exception of aspen sometimes, which can regenerate into a thick monoculture.

Diversity in younger age classes also varies but is lower than the older age classes. Many of these stands were likely created through clearcutting which initially simplifies stand structure.

The Forest Plan does not have specific within stand diversity objectives for the Lowland Conifer LE. These stands within the Project area typically occur as single species stands of black spruce or tamarack, or a mixture of both. Very few other species are found in any significant quantities within the Lowland Conifer LE.

3.7.6 Environmental Consequences

Alternative 1 – No Action
Direct and Indirect Effects

Indicator 1
Species Composition

In the Dry-mesic Red and White Pine LE, Alternative 1 would result in a considerable increase in the spruce-fir forest type as compared to the existing condition (Table 3.7-1). The succession rules in the forest modeling program convert aspen to spruce-fir at age 110. This substantial increase in the spruce-fir forest type corresponds with the decrease that occurs in the aspen forest type. Many of the aspen or aspen-spruce-fir stands within the Border Project area are on the verge of or beginning to convert over to spruce-fir. Most other forest types in the Dry-mesic Red and White Pine LE are stable throughout the projection period to 2014, with the exception of jack pine, which also converts over to a spruce-fir forest type when it reaches 120 years old. White pine, which is a MIS, would also have the same amount of acres in 2014 as in the existing condition. While no additional white pine would be gained through management activities, there would be some natural succession of aspen stands to white pine, where white pine currently exists as a component of the aspen stand.

In the Jack Pine-Black Spruce LE, Alternative 1 would result in a decrease in the aspen forest type and an increase in the spruce-fir forest type. This is again due to the old age of the aspen forest type in this LE. At age 110, forest modeling rules convert the aspen forest type over to a spruce-fir type. With the exception to the changes in aspen and spruce-fir, the other forest types in this LE hold relatively constant over the projection period. The white pine forest type would see a gain of 13 acres, moving from 1,257 to 1,273. As in the DRW LE, there would be acres gained in the white pine forest type through natural succession. Also, where white pine wouldn't become a forest type, it could still become a larger component of an existing forest type. An example of this could occur in a red pine forest type where there are white pine present. As small canopy gaps are created, white pine, being more tolerant of shade than red pine, could grow in these gaps.

Vegetation composition change would occur due to natural disturbances such as wildfires, insect infestations, disease outbreaks, and wind storms in addition to natural succession. The quantification of acres impacted by these disturbances would be difficult to do. Reconnaissance in some of these older age aspen stands indicates they are succeeding to spruce-fir. Natural succession would also transition these even-age stands into two-aged or multi-aged stands.

In the Lowland Conifer LE, Alternative 1 would not have much effect on the vegetation composition. Stands would get older and natural succession would occur. Single age class stands of black spruce and tamarack would begin to break apart and form two-aged stands.

Indicator 2
Age Class Distribution

Alternative 1, the no action alternative, would not create any new acres in the young age class in the Project area (Tables 3.7-3 to 3.7-5). Therefore, there would be no direct or indirect effects to age class distribution in the Border Project area for any of the three major LEs as a result of management activities. However, in the Dry-mesic Red and White Pine and Jack Pine-Black Spruce LE age class distribution would change as a result of natural succession and other actions. Some stands currently in the young age class would enter the next age class by the end of decade 1 of the Forest Plan (2014). This would decrease the amount of acres in the young age class. By 2014, there would be 786 acres in the young age class in the Dry-mesic Red and White Pine LE. Also in 2014, there would be 237 acres in the young age class in the Jack Pine-Black Spruce LE. These acres can mostly be attributed to past management actions. In the Lowland Conifer-A LE, there are no acres in the young age class. This is a result of no past management activity and no succession taking place in the Lowland Conifer-A LE.

Across all LEs, the difference between the amount of acres created in one age class and the amount succeeding to the next age class represents the overall change in the respective age class. For example, in the Dry-mesic Red and White Pine LE there is a 3,047 acre increase in the 10-49 age class when you compare the existing condition to the projection for Alternative 1 in 2014. Some of these new acres are a result of aging of the stand and movement into the 10-49 age class from the 0-9 age class. Similarly, old stands that were 110-120 years old convert to 10 year old stands based on forest modeling rules (Forest Plan EIS, Appendix B, p.B-17 to B-18).

Indicator 3
Within Stand Diversity

As noted, there would not be any treatments under Alternative 1, since it is the no action alternative. As such, all of the acres within the Project area would continue to age. In the short term, there would be minimal effects to within stand diversity.

In the long term, the amount of forest in the older age classes would gradually increase, which in turn would lead to greater stand complexity and diversity. Barring some widespread stand regenerating natural disturbance, in about 100 years most of the upland landscape would make its way into an older age class. This assumes that no harvest would take place in the future, which is appropriate for this no action baseline alternative. Stands that are structurally simple and have relatively few species such as aspen, would transition to spruce-fir stands that contain more vertical structure and generally more species diversity. As the short-lived forest types reach old age, substantial amounts of dead, dying, and down wood would become available, creating more structural diversity. Stands with longer-lived species (such as red pine and white pine) would also have more structural diversity through canopy gaps and down wood, although this would happen at a slower rate.

Alternatives 2 and 3
Direct and Indirect Effects

Indicator 1
Species Composition

The following treatments and their associated FACTS code (see Appendix A for definition of codes) have the potential to change the forest type of a stand based on species targeted for harvest and the type of regeneration that is proposed:

- Coppice cut w/reserves (FACTS code 4102)
- Clearcut w/reserves (FACTS code 4117)
- Seed-tree cut w/reserves (FACTS code 4134)
- Shelterwood seed cut w/reserves (FACTS code 4194)

In Chapter 1, the purpose and need for managing vegetation identified a need to increase the amount of spruce-fir forest type and decrease aspen in the Dry-Mesic Red and White Pine LE. Alternatives 2 and 3 would produce a substantial increase in the spruce-fir forest type, while decreasing the aspen forest type (Table 3.7-1). The large decrease in aspen is a result of harvest and regeneration methods which would convert many stands of aspen or aspen-spruce-fir into stands that have a majority in spruce, fir, or white pine species. Some older stands of aspen that were not harvested also contributed to the decrease in aspen acres. These older stands converted (based on modeling) to the spruce-fir forest type. This decrease in aspen is consistent with Forest Plan objectives, which seeks a large decrease in the aspen forest type (Forest Plan, p. 2-61 and 2-64).

While both alternatives would increase acres in the jack pine forest type through harvest and conversion, there would still be a decrease in acres in this forest type. This is a result of old stands of jack pine that would convert to the spruce-fir forest type by the end of the projection period in 2014. Many stands within the Project area do not allow harvest, due to vulnerable soil conditions; therefore, there would be the loss of jack pine acres due to succession. This loss of acres trends away from Forest Plan direction (Tables 3.7-1 and 3.7-2), which seeks an increase in the jack pine forest type.

The Border Project tries to maintain and increase the jack pine forest type under Alternatives 2 and 3, but is unable to do so because of various constraints. The first constraint is that there are a number of jack pine stands within the Project area that are either inaccessible or not economically efficient to access and propose harvests. These stands are 110+ years old, and by 2014, modeling rules would have them succeeding to a spruce-fir forest type. A second constraint is the lack of sites being harvested that are appropriate to convert to jack pine. Another constraint limiting the ability of the Project to help increase or maintain jack pine is the limitation of timber harvesting on some sites. There are numerous jack pine stands within the Project area that have exposed bedrock and/or have very shallow soils. These areas are off limits to harvest, as operating equipment on them has the potential to create irreversible damage to soil.

A final consideration, which not only limited maintenance of the jack pine forest type, but other forest types as well, is the lynx standard set forth in the Forest Plan (S-WL-1, p.2-30). Forest Plan standard S-WL-1 essentially limits the amount of forest on National Forest System land that can be in the 0-9 age class at any one time with each Lynx

Analysis Unit (LAU). The interdisciplinary team sought to create an alternative that harvested considerably more acres than Alternative 2, but was unable to do so because of the S-WL-1 guideline in the Forest Plan.

The white pine forest type would increase by approximately 1,000 acres, mainly through conversion of aspen stands after harvest. This addition of 1,000 acres to the white pine forest type is consistent with Forest Plan direction (O-WL-32, p.2-35) and the purpose and need of this Project. In addition, white pine would become a larger component of other forest types, such as in red pine and aspen. Many stands that are listed as having a red pine forest type also have a large component of white pine in them. Through harvest techniques and regeneration methods, white pine would be a target species to increase.

Red pine, oak, and northern hardwoods forest types would remain almost constant, while paper birch would see a decrease of approximately 150 acres. The loss of the birch forest type is inconsistent with Forest Plan objectives (Table 3.7-1 and 3.7-2). Areas in the Border Project where birch is being harvested often have no summer access, which limits the ability to accomplish proper site preparation for the regeneration of birch. The only noticeable difference between Alternative 2 and 3 is in the aspen and spruce-fir forest types. There is less harvesting in Alternative 3 as opposed to Alternative 2, and so this would result in more aspen converting via succession into the spruce-fir type in Alternative 3.

Under both Alternative 2 and Alternative 3, composition in the Jack Pine-Black Spruce LE show similar trends as the Dry-mesic Red and White Pine LE as it relates to the aspen and spruce-fir types, except on a smaller scale. This also fits with the purpose and need of the Project as identified in Chapter 1. Aspen would decrease by 430 acres, while spruce-fir would increase by 287 acres. Jack pine acres would increase by 101 acres. This would mainly be achieved through conversion of aspen stands found on soil types that are more conducive to growing jack pine (i.e. drier, sandier soils). Red pine, white pine, oak, northern hardwoods, and paper birch would all remain relatively constant within the Project area throughout the projection period. While white pine would not see any significant increase in acres as a forest type, it would become a larger component of other forest types where it exists.

In Alternatives 2 and 3, there are a total of 63 and 57 acres, respectively proposed to be harvested in the Lowland Conifer-A LE in. All harvests would be in either the black spruce or mixed swamp conifer forest types. Forest Plan objectives seek to maintain current forest type percentages, so all harvested acres would be regenerated to their existing forest type.

Indicator 2
Age class distribution

The analysis considered natural succession and management actions such as timber harvest that effect age class by creating new young stands. The following treatments would result in a new stand in the young age class:

- Coppice cut w/reserves (FACTS code 4102)
- Clearcut w/reserves (FACTS code 4117)
- Seed-tree cut w/reserves (FACTS code 4134)
- Shelterwood seed cut w/reserves (FACTS code 4194)

The amount of young age class for the Dry-mesic Red and White Pine (DRW) LE in the Project area would increase under both action alternatives. This again is consistent with the purpose and need for the Project identified in Chapter 1. Under Alternative 2, 7,972 acres of young age class would be created in the Project area from past actions and current proposals of timber harvest using the methods listed in the previous paragraph (Table 3.7-3). Alternative 3 would create 6,764 acres of young age class. Most of these acres would come from harvests that would take place in the 50-99 and 100-139 age classes. The 10-49 age class would see an increase in acres, as acres from the 0-9 age class would get older, and natural succession would have some stands moving from the 100-139 age class down to the 10-49 age class. More acres are found in the 50-99 and 100-139 age class in Alternative 3 as opposed to Alternative 2, because there are fewer acres proposed for harvest. This of course is reflected in the 0-9 age class where Alternative 3 has fewer acres. The 140+ age class would see a 129 acre increase under both alternatives as compared to the existing condition.

Table 3.7.3 Age Class Composition in the Dry-Mesic Red and White Pine LE

Age Class	Forest-wide [1]			Border Project Area[3] (Acres)			
	Existing Condition (2007)	Projected Condition (2014)[4]	Objectives[2] for Decade 1	Existing Condition (2007)	Alt. 1	Alt. 2	Alt. 3
0-9	8%	9%	10%	2,280	786	7,972	6,764
10-49	35%	41%	44%	11,027	14,074	13,351	13,551
50-99	45%	36%	32%	16,293	11,996	8,309	8,911
100-139	12%	14%	14%	8,447	11,017	8,287	8,692
140+	0%	0%	0%	242	416	371	371
Total	100%	100%	100%	38,290	38,290	38,290	38,290

[1] Percent of National Forest System land in the Dry-Mesic Red and White Pine LE.
[2] Superior National Forest, Forest Plan, page 2-64, Table DRW-2.
[3] Figures displayed for all alternatives reflect NFS land in year 2014.
[4] See Appendix G for list of projects included in projection.

Projected conditions in 2014 indicate that all age classes within the DRW LE are moving towards or are at Forest Plan objectives for decade one. Alternatives 2 and 3 would move all age classes toward Forest Plan objectives, with the exception of the 100-139 age class in Alternative 2, which would see a slight decrease in acres from 8,447 to 8,287. This is a result of a number of old aspen and jack pine stands proposed for harvest in this age class. Alternative 1would move all age classes towards Forest Plan objectives as well, with the exception of the young age class. This is, of course because no harvests would take place under Alternative 1.

Alternatives 2 and 3 would have identical outcomes on age class distribution in the Jack Pine-Black Spruce (JPB) LE, as they both propose treatments for the exact same stands. Consistent with the purpose and need of the Project, these alternatives would increase the amount of young age class in the JPB LE. 1,075 acres of young age class would be created in the Project area from past actions and current proposals (Table 3.7-4). Acres in the 80-109 age class would see a decrease of 1,247 acres, as a result of harvest and movement to the next age class. The 110-179 age class would see an increase of 661

acres as compared to the existing condition. The 50-79 age class would drop to only 55 acres within the Project area.

The projections for the JPB LE show age class distributions moving in a positive direction for all age classes (Table 3.7-4). Most age classes are projected to be within one to two percent of Forest Plan objectives for decade one, with the exception of the 0-9 age class. This age class would still be five percent short of its goal by the end of decade one. Due to the small amount of this LE within the Border Project area, all of the alternatives would contribute very little to the forest-wide LE objective for age class distribution. The end of the first decade of the Forest Plan is not until 2014, therefore future projects could contribute towards meeting young age class objectives for this landscape ecosystem.

Forest-wide projections show that age classes within this LE are trending in the right direction (Table 3.7-5). All age classes are moving towards decade one objectives, with the exception of the 80-159 age class. This age class is projected to be two percent higher than Forest Plan objectives for decade one, and is actually moving away from decade one objectives. This would be attributed to the lack of harvest within this lowland conifer system. All three alternatives do very little towards contributing towards age class objectives for this LE. In the case of the action alternatives, this is because there are very few acres of forest type within this LE that are suitable for timber production. Alternatives 2 and 3 would add a small amount (63 and 57 acres, respectively) to the young age class, which contributes toward Forest Plan objectives. The proposed harvests in the action alternatives are all in the 80-159 age class; helping to alleviate the over-abundance of acres in this age class. In all other age classes, the alternatives are nearly identical as to their impacts on the forest-wide LE objectives. With six years left until the end of decade one, future projects would have the potential to address this issue.

Table 3.7.4 Age Class Composition in the Jack Pine-Black Spruce LE

Age Class	Forest-wide [1]			Border Project Area[3] (Acres)			
	Existing Condition (2007)	Projected Condition (2014)[4]	Objectives[2] for Decade 1	Existing Condition (2007)	Alt. 1	Alt. 2	Alt. 3
0-9	7%	9%	14%	475	237	1,075	1,075
10-49	39%	41%	42%	2,518	3,007	2,895	2,895
50-79	23%	21%	18%	446	114	55	55
80-109	25%	24%	22%	2,349	1,578	1,102	1,102
110-179	5%	5%	5%	381	1,233	1,042	1,042
180+	0%	0%	0%	0	0	0	0
Total	100%	100%	100%	6,169	6,169	6,169	6,169

[1] Percent of National Forest System land in the Jack Pine-Black Spruce LE.
[2] Superior National Forest, Forest Plan, page 2-61, Table JPB-2.
[3] Figures displayed for all alternatives reflect NFS land in year 2014.
[4] See Appendix G for list of projects included in projection.

Table 3.7.5 Age Class Composition in the Lowland Conifer-A LE							
Age Class	Forest-wide [1]			Border Project Area[3] (Acres)			
	Existing Condition (2007)	Projected Condition (2014)[4]	Objectives[2] for Decade 1	Existing Condition (2007)	Alt. 1	Alt. 2	Alt. 3
0-9	0%	1%	3%	0	0	63	57
10-39	7%	5%	5%	53	53	53	53
40-79	24%	20%	18%	96	22	22	22
80-159	66%	71%	69%	2,262	2,337	2,274	2,280
160+	2%	3%	4%	195	195	195	195
Total	100%	100%	100%	2,607	2,607	2,607	2,607

[1] Percent of National Forest System land in the Lowland Conifer-A LE.
[2] Superior National Forest, Forest Plan, page 2-76, Table LLC-2a.
[3] Figures displayed for all alternatives reflect NFS land in year 2014.
[4] See Appendix G for list of projects included in projection.

Indicator 3
Within stand diversity

Tree species diversity objectives are located in the Forest Plan (p.2-65, Table DRW-3 and p.2-62, Table JPB-3), and differ from the forest type objectives in that they address the desired direction for total percentages of trees, not total acres of forest type. Tree species diversity has declined in the Great Lakes region over the past 200 years due to land use (Schulte et al, 2007). Many stands have become dominated by a single species and have lost the diverse mix of species that once made them resilient to disease and insects.

Species diversity in the Project area would generally increase under both action alternatives as desired in the Forest Plan (p.2-22, D-VG-6d) and the purpose and need of the Project. There is a total of 4,712 acres of planting proposed under Alternative 2, and 4,535 acres proposed under Alternative 3. Planting would be targeted to diversify the species mix within a given stand. As an example, an aspen stand that is proposed to be converted to spruce-fir, may also be planted with white pine as well (if site appropriate) in order to provide for a wider range of species in the new stand. Another example of diversification would be a red pine shelterwood harvest, where white pine would be planted in the understory to add an additional species.

Species diversity would also be enhanced through harvest. Silvicultural practices can be tailored so that species that may be under-represented within a stand can be managed in such a way that they have a chance to flourish. An example of this would be the group selection harvest method in a red pine stand that has an understory of white pine and/or white spruce. White pine and white spruce are intermediate in terms of their ability to tolerate growing in the shade. While they are able to grow in shade initially, if not given adequate sunlight over a certain period of time, they will die. In the group selection harvest, a group of trees is selected for harvest (varying in size from ¼ to 1 acre). With the overstory trees removed, the white pine and white spruce in the understory can now take advantage of the increased sunlight. Species diversity is maintained or increased, and vertical structure within the stand is increased by adding these group openings.

Given the amount of even-aged treatments in the Project area (Table 1.1), structural diversity would be expected to decrease initially, because treatments such as clearcut and shelterwood harvests simplify stand structure. Effects would be mitigated by the requirement of leaving 6-12 leave trees per acres and legacy patches in clearcut treatments (Forest Plan, D-VG-6, part e, page 2-22 and D-VG-8, page 2-23). Decreases in structural diversity caused by even-aged treatments would be off-set to a certain extent by the 2,036 acres of group selection harvests. These treatments would create gaps in the canopy and thus add to vertical structure.

Overall, structural diversity would be slightly higher under Alternative 3 as opposed to Alternative 2, as there are 862 fewer acres proposed for even-aged treatments. On the other-hand, species diversity could be higher in Alternative 2 as opposed to Alternative 3, given that there is 177 acres more of planting in Alternative 2.

Cumulative Effects for Alternatives 1, 2, and 3

Indicator 1
Species Composition

Vegetation composition data was obtained from the State of Minnesota and the St. Louis County Land Department in 2007. This data included the existing condition of their forest types, as well as their harvest plans for the foreseeable future. Vegetation composition data for private ownership was obtained through aerial photo interpretation.

As can be seen in Table 3.7-6, there is no projected change in species composition on either State of Minnesota or St. Louis County land within the Project area. The table also shows that all private land is projected to stay in the same species composition as is currently present. Forest types in private ownership are projected to stay the same based on the assumption that private landowners do not set forest type conversion or forest management in general as a high priority (Baughman & Updegraff, 2001). Private forest landowners typically list recreation, wildlife habitat, hunting, esthetic enjoyment, and numerous other reasons for owning land rather than timber production or timber income.

While the State and county are not planning to convert any of their forest types from one to another through management activity, it could be reasonably assumed that some mature and older aspen and jack pine stands would probably start succeeding to a spruce-fir forest type. The same succession scenario could also be applied to private land. Due to no projected change in species composition on State, county, and private ownership, the potential cumulative effects would be the same as the direct and indirect effects.

There are no other federal vegetation management projects on-going or being proposed that overlap with the Border Project boundary, therefore, the only cumulative effects in the Project area would be those of the State of Minnesota, St. Louis County, and private landowners.

Table 3.7.6 Vegetation Composition on All Ownerships in the Border Project Area

Forest Type	NFS land[1]				State Land		St. Louis County Land		Private Land		All Ownerships			
	2007	Alt 1 2014	Alt 2 2014	Alt 3 2014	2007	2014	2007	2014	2007	2014	Total 2007	Alt 1 Total 2014	Alt 2 Total 2014	Alt 3 Total 2014
Jack pine	6,812	6,423	6,705	6,667	460	460	637	637	1,509	1,509	9,418	9,029	9,311	9,273
Red pine	3,295	3,295	3,350	3,282	617	617	699	699	203	203	4,814	4,814	4,869	4,801
White pine	8,060	8,076	9,170	9,136	785	785	304	304	348	348	9,497	9,513	10,607	10,573
Spruce-fir	2,299	4,761	4,518	4,792	420	420	461	461	556	556	3,736	6,198	5,955	6,229
Oak	110	110	110	110	0	0	0	0	0	0	110	110	110	110
Northern hardwoods	720	720	720	720	94	94	34	34	0	0	848	848	848	848
Aspen	22,009	19,966	18,881	18,747	3,103	3,103	4,694	4,694	5,953	5,953	35,759	33,716	32,631	32,497
Paper birch	1,153	1,107	1,004	1,004	6	6	149	149	133	133	1,441	1,395	1,292	1,292
Black spruce	2,542	2,542	2,542	2,542	537	537	282	282	483	483	3,844	3,844	3,844	3,844
Tamarack	65	65	65	65	150	150	114	114	0	0	329	329	329	329
Northern White Cedar	509	509	509	509	162	162	172	172	0	0	843	843	843	843
Lowland hardwoods	1,888	1,888	1,888	1,888	255	255	379	379	184	184	2,706	2,706	2,706	2,706
Total	49,462	49,462	49,462	49,462	6,589	6,589	7,925	7,925	9,369	9,369	73,345	73,345	73,345	73,345

[1]For the Jack Pine/Black Spruce, Dry-Mesic Red and White Pine, and Lowland Conifer-A LEs

Indicator 2
Age class distribution

Under Alternative 1, there would be a large reduction in acres in the young age class when you look at federal, State; county and private land actions over the projection period (Table 3.7-7). There would be no harvesting on federal land, and while both the State and county have harvests planned that would create acres in the young age class, it would not be enough to off-set the acres that would be lost in the young age class under the existing condition (Tables 3.7-8 and 3.7-9).

Cumulative effects to the Project area until the end of decade 1 (2014) would result in a considerable increase of the 0-9 age class for both action alternatives (Table 3.7-7). Action alternatives would cumulatively move most age classes closer to desired levels. The majority of acres created in this age class would come from the Border Project. While both the State of Minnesota and St. Louis County would contribute to creation of acres in the young age class throughout this projection period, by 2014, both agencies are projected to have considerably less acres in the 0-9 age class than they do now.

Table 3.7.7 Acres in the Young Age Class (0-9) on All Ownership in the Project Area[1]

Existing (2007)	Alt 1 (2014)	Alt 2 (2014)	Alt 3 (2014)
4,914	1,914	10,001	8,787

[1]Acres from NFS land are for Dry-mesic Red & White Pine, Jack Pine-Black Spruce, and Lowland Conifer-A Landscape Ecosystems.

Table 3.7-10 shows a breakdown of acres by age class on private ownership. These acres were determined by aerial photo interpretation, and while an exact age from this type of observation was not possible, it was not necessary for this analysis. For purposes of this analysis, the most important information was whether or not the forest types were recently created or mature, and photo interpretation provided the opportunity to do this. Also, while projecting the amount of harvest activity that may take place on private ownership is nearly impossible, it can be assumed that some level of harvest would take place. Those harvests would add a minimal amount of acres to the young age class based on harvest activity from the recent past and studies that have shown that timber production is a low priority for private forest landowners (Baughman & Updegraff, 2001).
As mentioned for Indicator 1, there are no other federal vegetation management projects in the foreseeable future that overlap with the Border Project, therefore, cumulative effects consist of effects from decisions by the State of Minnesota, St. Louis County, and private landowners.

Table 3.7.8 Age Class Composition for State of Minnesota Land within the Project Area

Age Class	Existing Condition (2007)	Projected Condition (2014)
0-9	754	174
10-49	1,373	2,039
50-99	3,224	2,793
100-139	1,079	1,359
140+	159	224
Total	6,589	6,589

Table 3.7.9 Age Class Composition for St. Louis County Land within the Project Area		
Age Class	**Existing Condition (2007)**	**Projected Condition (2014)**
0-9	1,284	596
10-49	1,366	2,366
50-99	5,148	4,603
100-139	103	336
140+	29	29
Total	7,930	7,930

Table 3.7.10 Age Class Composition for Private Ownership Land within the Project Area		
Age Class	**Existing Condition (2007)**	**Projected Condition (2014)**
0-49	121	121
50+	9,248	9,248
Total	9,369	9,369

Indicator 3
Within stand Diversity

Cumulative effects to within stand diversity as it relates to species diversity would be similar to those that are mentioned under direct and indirect effects. For Alternative 1, while there would be no harvest on federal land, harvests would still take place on State, county, and private lands. Species diversity would slowly increase on federal lands through succession. On sites where harvests took place on other ownerships, effects to species diversity would depend on the harvest type. Clearcuts would initially decrease species diversity, while thinnings could potentially increase diversity. Succession would of course also take place on other ownership lands that are not proposed for harvest, which would increase species diversity. Alternatives 2 and 3 would see the same results, only with federal actions added in.

Cumulative effects to stand structure would also be similar to that of direct and indirect effects. Thinnings and selection harvests have the potential to create more stand structure, and can actually accelerate the progression of a stand to have more mature forest characteristics. Clearcuts would initially simplify stand structure. This can be mitigated to a certain extent by the creation of reserve areas or legacy patches which would leave pockets of mature forest. Most changes to within-stand diversity would come through federal actions, as both the State and county plan to harvest a minor portion of the Project area. Also, as mentioned earlier, private harvest is expected to have little impact, judging by the small amount of harvest activity that has taken place in the recent past.